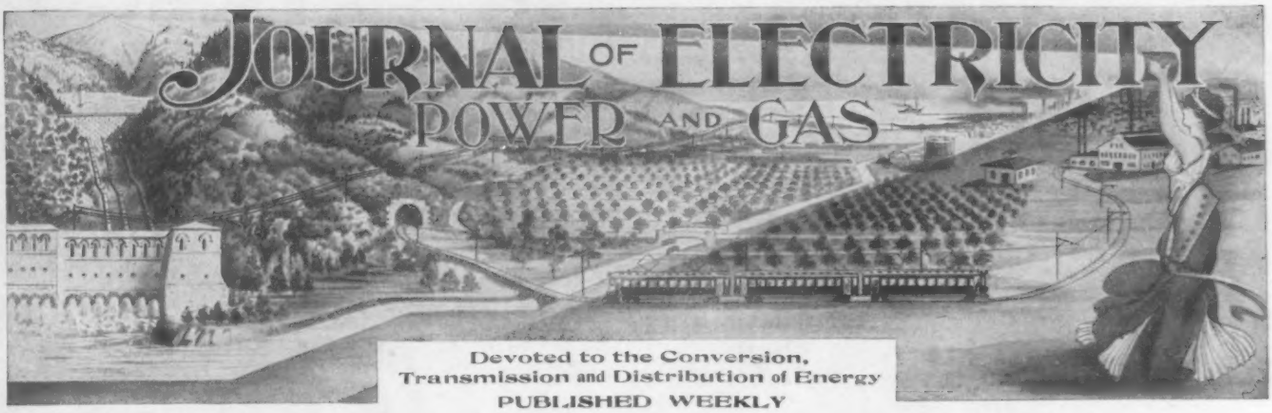

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THE

Journal of Electricity, Power and Gas

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XX. SAN FRANCISCO, CAL., MARCH 21, 1908 No. 12

ELECTRICAL GENERATING STASION AT BRUSSELS.

By J. B. VAN BRUSSEL.

An interesting account of the application of American boilers to European needs is contained in this account of the new central station at Brussels.

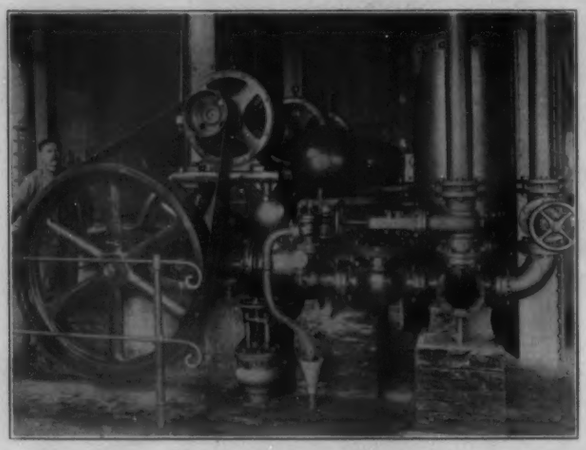
In 1893 the first electric plant was built in Brussels, with a capacity of 1,000-horsepower, for operating a continuous-current dynamo, supplying current on the three-wire system at 110 volts. There were also two small sub-stations, working in conjunction with the main central station, and these contained gas engines of 120 and 60 horsepower. It soon became apparent that the demand was greater than the supply, and in order to cope with the increased requirement, three new engines of 500-horsepower each were subsequently added, and these also were shortly augmented by three others, each capable of developing 1,000 horsepower. In ten years' time, that is, at the close of 1903, the total power available amounted to 6,500 horsepower, and there was a further accumulator capacity of 19,400 ampere-hours. The rapid increase had surpassed the expectations of the designers of the station, and so about this time the construction of new works was carefully considered, and it was decided to build a new station. The new works, which were commenced in 1904, have just been completed at the Quai des Usines, on the banks of the Willebroeck Canal, near to Schaerbeek-Station.

The foundation of the machinery and boiler-houses is of concrete, 75 cm. deep, which rests on a sand bed of 80 cm. thickness. The reinforcement of the concrete consists of transverse and longitudinal steel bars and wire. The main building, containing the machinery and boilers, consists of a steel framework, which rests on masonry. A metal chimney stack is used, and this alone weighs 1,200 tons, and has a height of 195 feet. Two masonry aqueducts have been built for the supply of condensation water. Each of the aqueducts discharges water into a canal through four pipes, each two feet in diameter. A fan fitted to the pipes facilitates the discharge. On the aqueduct leading from the condenser there is an oil separator, consisting of a series of masonry baffles.

ENGINE ROOM OF BRUSSELS GENERATING STATION.

The distance between the collecting and discharging ends of the aqueduct is 100 m.

The boiler-house is 100 feet in length by 55 feet broad, and contains ten Babcock & Wilcox boilers. Each boiler has 3,600 square feet of heating surface, and a grate area of 31 square feet. The plant is divided into five groups of two boilers, and each boiler is fitted with a superheater, which has 545 square feet of heating surface. The normal working pressure of the boilers is 215 pounds per square inch. A Green economizer is used in conjunction with the boiler plant, and is divided into two units, which together have a total heating surface of 19,600 square feet. There is a by-pass between the economizer and the boilers, which allows the gases to be sent direct to the chimney without first passing through the economizer, should this course be desired. Water is supplied to the boilers by electrically-driven "Express" pumps, which have a duty of 66,150 pounds of water per hour, or approximately 6,600 gallons. The motors are mounted above the tops of the pumps, which they drive by means of belts. In a plant of this description it is almost a necessity to have a large pumping plant as a stand-by, and for this purpose two Worthington pumps having a duty of 55,000 pounds an hour are used.



ELECTRICALLY DRIVEN FEED PUMP.

The main feed-pipe, which is made of weldless steel, is duplicated, one of the branches passing through the economizer, the other going direct to the engines. A water-softener plant of 10,000 gallons an hour capacity is used to supply the feed-pumps with purified water for the boilers. The condensed water is pumped into the purifiers by means of two centrifugal pumps, each of which has a capacity of about 6,000 gallons an hour. They are operated by motors of four and one-half horsepower, having a potential difference of 220 volts. The motors are direct-coupled to the pumps, and they are all mounted on a common foundation bed.

The plant erected for handling the coal is designed for dealing with twenty tons per hour. The coal is brought to the works either by boat or railway, and unloading is carried out by means of an electric crane capable of lifting two and one-half tons. The coal is deposited on a Robins belt, on which it is taken to the bunkers. This conveyor passes underneath the quay, and is inclined at a gradient of one in five to the bunkers. From here the coal is carried to the main building by a second belt, and on its way there it is weighed in a Blake-Denison automatic weighing machine. The stokers also weigh the quantity of coal consumed by each boiler, by means of a Schenk weighing machine.

The engine-house is a large, well-lighted building, its principal dimensions being 300 feet in length by 86¼ feet wide. At the present time the plant comprises four combined sets of engines and generators, but there is plenty of room for two auxiliary units when they are required. Three of the units have an output of 3,100 kilowatts each; the fourth is somewhat smaller, being only 1,800 kilowatts. The engines have not all been made by the same firm; those for one of the large alternators, and the small ones, were constructed by the firm of Van den Kerchove, the special feature in these engines being the use of piston valves, which are actuated by a trip gear. The other engines were built by the firm of Carels Brothers, and the valves of these engines are of the Sulzer type. Each unit consists of a horizontal compound steam engine, which drives a three-phase alternator. The engines are condensing, the barometric principle having been adopted, the apparatus used being shown in the engraving.

The following are the principal dimensions of the Van den Kerchove engines:

	First Engine.	Second Engine.
Diameter of high-pressure cylinders.	26 in.	34¼ in.
Diameter of low-pressure cylinders.	45 in.	5 feet.
Area of H.P. cylinder / Ratio Area of L.P. cylinder	2.99	2.97
Stroke	54	5 feet.
No. of revolutions per minute	94 in.	83
Piston speed	14 ft. per sec.	13.8 ft. per sec.
Working pressure	140 lbs. per sq. in.	140 lbs. per sq. in.
Normal admission	0.32	0.32
Horsepower	2,600	4,500

The Carels' engines are also condensing. The valves are of the double-seated equilibrium type, and they are actuated in the usual manner by means of four eccentrics on the crank shaft, two for operating the admission valves, and two for the exhaust valves. The releasing gear is worked from the same rods as the valves, in order to reduce the inertia of their motion. This mechanism is a special device introduced by Carels-Sulzer to prevent any damage being caused owing to shock, and at the same time it is claimed to give swiftness in running. The principal dimensions of the Carel engine are:

Diameter of high-pressure cylinder	33½ in
Diameter of low-pressure cylinder	55 in.
Ratio of Area of low-pressure cylinder / Area of high-pressure cylinder	2.71
Stroke	53.14 in.
Number of revolutions per minute	83
Piston Speed	12.5 ft. per second
Working pressure	240 lbs. per sq. in.
Cut-off high-pressure cylinder	0.435
Horsepower	4,500

There are three condensers, and the exhaust steam from each engine enters a common pipe in which the vacuum is maintained by one of the three condensers already referred to. The condensation water is taken from the feed-water

aqueduct, and pumped up to the top of the barometric condensers by means of electrically-driven pumps which are of approximately 150 horsepower. Each unit produces a vacumm of 92 per cent, at normal working, which is 1,250,000 pounds of steam an hour, and of 88 per cent, at an output of 1,500,000 pounds of steam per hour, the water being at 10 degrees Centigrade when it is taken out of the canal.

The three large 3,100 kilowatt-ampere alternators generate tri-phase current of 5,000 volts at 83 revolutions per minute. Each alternator has 72 poles and a frequency of 50 per second. The armature is 19 feet inside and 21.75 feet outside diameter, its weight is about 33½ tons, and the total weight of the field magnets is 75 tons. The following figures were guaranteed by the makers when the machines were ordered:

Load.	5/4.	1	½
Efficiency	97 pr cent.	97 per cent.	95 per cent.
Excitation in kw....	40	37.2	32

CONDENSING PLANT.

The makers further maintained that the alternators would sustain an overload of 15 per cent for two hours, and of 40 per cent for three minutes. The variation of the pressure between full load and when running light lies between 7 and 8 per cent. The rise in temperature of the windings of the armature and field magnets after eight hours' running at full load does not exceed 45 degrees Centigrade, and after two hours' running, at 15 per cent overload the temperature does not exceed 55 to 60 degrees Centigrade. The high-tension windings were tested with a voltage of 10,000 for half an hour, and the excitation windings with a pressure of 500 volts.

The smaller alternator, which is an 1,800-volt-ampere machine, is of the same type as the others. Its normal speed of running is 94 revolutions per minute, and it has 64 poles. A somewhat similar guarantee was given with this machine to that just quoted. At a quarter overload the efficiency is 96.5 per cent., and it is the same for full load, whilst at half load it drops to 94.5 per cent.

Two groups of rotary converters driven by steam engines, supply the necessary continuous current for the excitation of the tri-phase alternators, as well as the current for working the motor-driven pumps, and also for charging the battery of accumulators. The transformer sets consist of a synchronized tri-phase motor coupled direct to a continuous-current dynamo. The motor develops 275 horsepower at 5,000 volts at its normal speed of running, 250 revolutions per minute. The dynamo is a 200-kilowatt machine, and generates current at 250 volts.

A small steam-driven plant for excitation purposes is illustrated in Fig. 3. The steam engine is one of Carels' high-speed type, and is fitted with rotary valves. At 220 revolutions per minute the dynamo develops 95 kilowatts at 220 volts. In the guarantee which the makers gave it was stated that the efficiency at one-quarter overload would be 94 per cent, and the same for full load. At half load the efficiency would be 90 per cent. There is a battery of accumulators automatically controlled for charging and discharging, which is used for supplying current for lighting, and at the same time to act as a regulator. This battery consists of 130 Tudor cells, having a capacity of 540 ampere-hours for discharge of three hours. The current for the lighting and power used in works is obtained from the bus-bars of the batteries and exciters.

Considerable care was exercised in the design and construction of the switchboard and its auxiliary gear in order to make everything as automatic as possible, and to ensure safety with the use of high voltages. The switchboard is placed on a platform about 13½ feet above the floor level. The high-tension wires are connected behind the board, and are there protected by wire netting. The different high-tension systems are protected the one from the other by masonry partitions. All the high-tension switches have oil breaks operated from some distance away by mechanical means, so that they need not be touched by hand. The measuring instruments are worked with transformers, which are earthed so that it is impossible to get a shock if they are touched.

The switchboard can be subdivided, so that, if necessary, alterations and repairs can be performed without stopping the plant. A synchronism indicator and control volt-meters are placed in prominent positions on the board. There are no fuses in the high-tension circuits, these being protected by a maximum cut-out device of maximum with delayed action. The high-tension feeders are further protected by Warth lightning arresters branched triangularly between the phases which come into operation in case of accidental rises in voltage. A static earth indicator, made by the General Electric Company, is the only high-tension measuring instrument on the switchboard, and this is placed quite out of reach of any of the operators.

The current from the central station is transmitted to five sub-stations, each of which can be isolated from the others. These sub-stations, called as A, B, C, D, and E, do not differ one from the other, except in the number and size of the units they contain. The sub-station A contains four groups of rotary converters of 700 kilowatts, and one battery of 7,800 ampere-hours capacity. The sub-station B has six groups of rotaries, each of 375 kilowatts capacity, and a battery of 3,000 ampere-hours capacity. The sub-stations C, D, and E, each comprise two groups of 200-kilowatt rotaries, and batteries of accumulators with a capacity of 3,000, 2,000, 3,600 ampere-hours, respectively. The rotary converters consist of synchronous motors receiving current at 5,000 volts, direct-coupled to continuous-current dynamos generating current at 250 volts. As the delivery of the current is on the three-wire system, balancers have been provided.

GENERAL THEORY OF COMMUTATION AND OF THE REPULSION MOTOR.*

By E. F. Alexanderson.

The pure repulsion motor has a rotating field, and it appears plausible that commutation may be good in a rotating field, provided that the armature rotates at approximately the same speed as the field. However, a rotating field is not in itself a guarantee of good commutation.

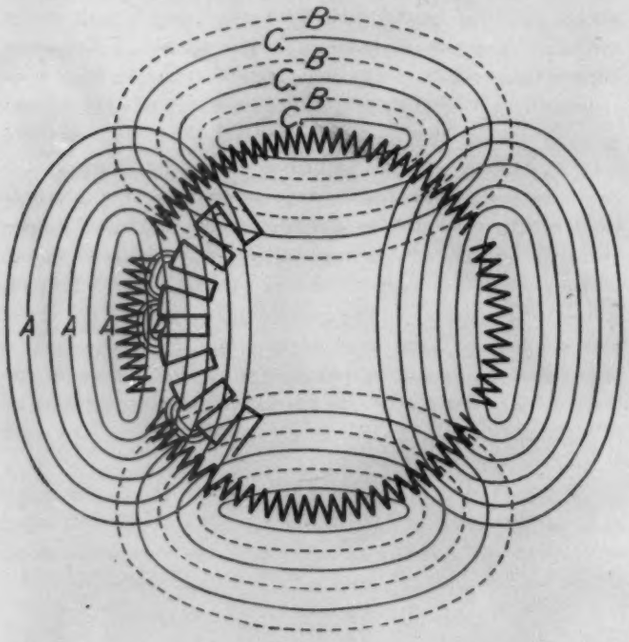


Fig. 2

When the field becomes ellipitical in shape, it is difficult to grasp the phenomena of commutation unless the field is resolved into its components and expressed as functions of time and space. If this is done, the following field components influence the commutation, as illustrated in Fig. 2.

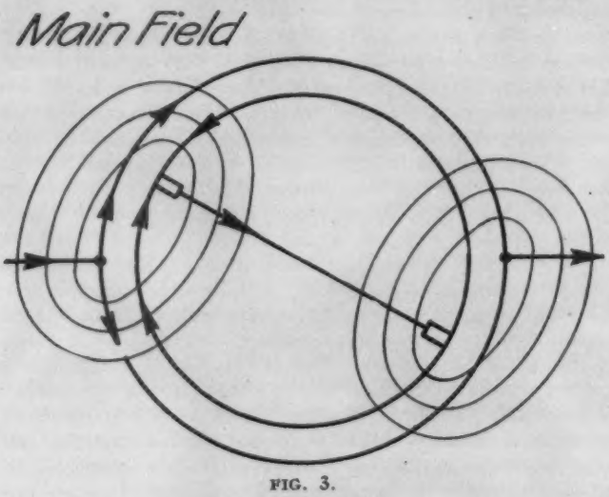


FIG. 3.

A. The "main field," which is the torque-producing field, and corresponds to the field in a series motor.

B. The cross-field magnetized by an exciting current flowing in the armature, and serving to transfer the energy from rotor to stator. This field is in quadrature with the main field in time as well as space.

C. Another cross-field magnetized by the difference between the ampere-turns of the armature and the inducing winding. This field is in phase with the main field.

D. The leakage flux around the commutated coils.

The conditions for perfect commutation are as follows:

1. The electromotive force of alternation of the main field should be neutralized by the electromotive force of rotation in the cross-field designated "B."

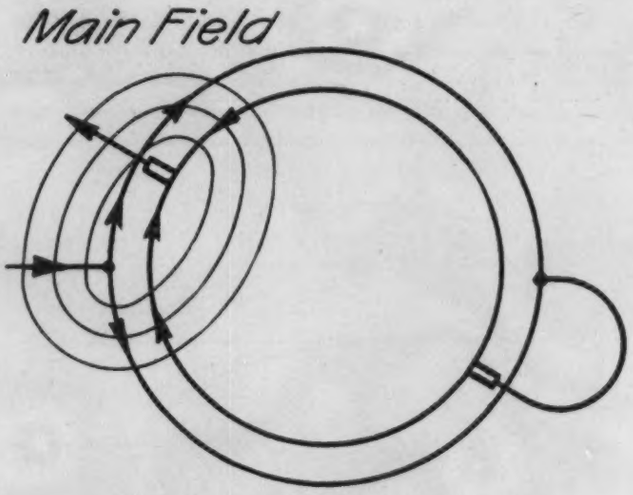


FIG. 4.

2. The magnetomotive force of the stator should be larger than the armature reaction; the difference, which is the field designated "C," should be large enough to overcome the voltage due to the leakage flux.

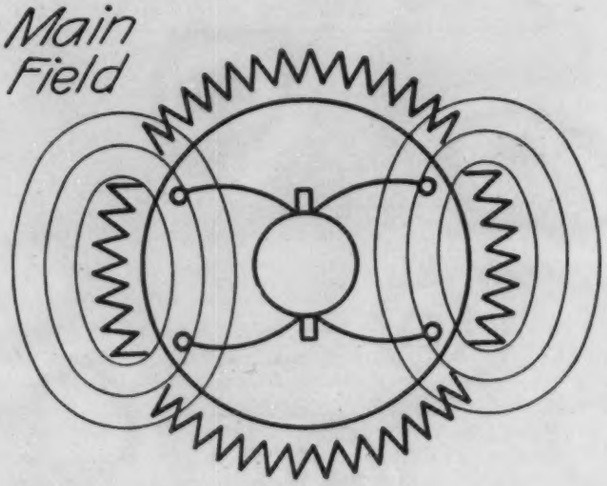


FIG. 5.

If these conditions are fulfilled the commutation is identical with that of a direct-current motor with commutating poles.

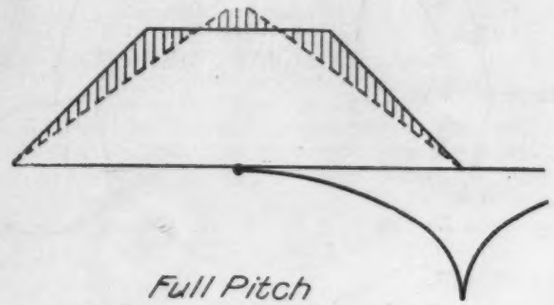
The first condition is found at synchronous speed in a repulsion motor, and theoretically in a series motor at infinite speed. In a series repulsion motor it can be obtained at any speed by varying the proportion between series and repulsion motor action.

*Abstract of paper presented before the American Institute of Electrical Engineers, New York, January 10, 1908.

This, however, meets only one of the fundamental conditions necessary for good commutation; there are others which will affect commutation as much as will shifting the brushes of a direct-current motor from the right to the wrong side of the neutral.

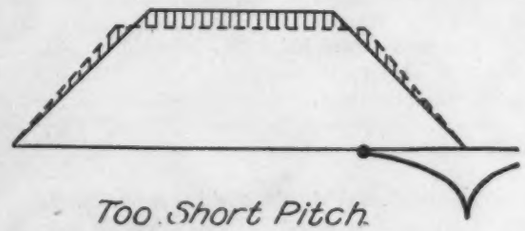
The type of motor which is generally referred to as a repulsion motor is that with a continuous stator and rotor winding, and the brushes shifted in the direction of rotation as in Fig. 3.

If such a motor is used as a series motor with a stator and rotor connected in series, it is apparent from the diagram shown in Fig. 4 that that part of the windings which is included in the angle represented by the shift of the brushes constitutes the exciting coils, and the lines of force are distributed as shown on the diagram. The brushes are shifted in the direction of rotation and are located on the edge of the active field. It is well known in direct-current practice that



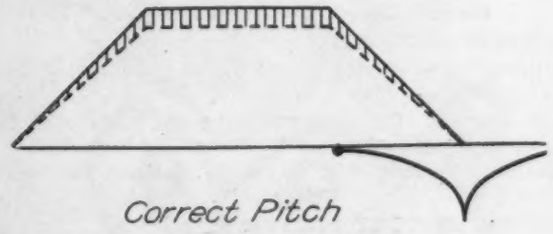
Full Pitch

Fig. 6a



Too Short Pitch

Fig. 6c



Correct Pitch

Fig. 6b

the brushes of a motor ought to have a backward shift, if any, but never a forward shift; and it is therefore obvious, considering the direct-current features, that this motor cannot commutate well. In the repulsion motor, the armature currents are induced by the transformer action, but the distribution of the currents is substantially the same as described above for the series motor. This difficulty has led to the design of an armature winding as shown on Fig. 5, by which the electromotive force due to the cutting of the active flux is eliminated. The magnetization is produced by a separate stator winding located symmetrically with respect to the brushes. This gives a distribution of the fields as shown in Fig. 5. The armature conductors under commutation are located on the edge of the field flux, so that both sides of the coil are under an equal flux of the same polarity.

There is another way of looking at this phenomenon which leads to the same result: the winding of the repulsion motor can be separated into an exciting winding and an inducing winding; in this case the brushes are located in the neutral of the stator winding. The armature is the short-circuited secondary of the inducing winding and must consequently have substantially the same total number of ampere-turns. The two fields that are excited by the stator and rotor individually are shown in Fig. 6 (a). The rotor field is peaked and stator field is flat-topped, giving a resulting field as shown by the cross-section part of the diagram. Consequently, there is a resulting peaked field opposite to the brushes where the conductors under commutation are located. This field is excited by the armature and has all the detrimental effects of armature reaction. Fig. 6 (b) shows how this is overcome by a fractional pitch winding on the armature. It also shows why only one definite winding pitch gives the correct result, whereas a greater or less ratio gives a field in the wrong direction.

The correct combination in Fig. 6 (b) shows the rotor flux slightly lower than the stator flux, whereas if there were no leakage the currents and corresponding fluxes would be equal; but actually, the primary is a little higher, due to the leakage. The difference between these two fluxes acts as a commutating field; but, on the other hand, the higher the leakage, the higher will be the commutating flux needed to overcome the leakage. If, however, the armature is short-circuited through a reactive coil, the resulting flux is increased without introducing leakage in the armature. Since the field of the motor is a reactive coil itself that must be excited, a convenient way of introducing reactance into the motor armature is to use the motor field or a part thereof for this purpose. That it is beneficial for the commutation of a repulsion motor to introduce the field in the armature instead of the stator circuit, was experimentally demonstrated long ago by E. W. Rice, Jr. The reason for the improvement as explained above, is that the reactance of the field changes the ratio between stator and rotor ampere-turns so as substantially to offset the wrong distribution of currents with the full-pitched winding. The fact of the reactive coil being the field winding is in this respect immaterial, and it has been proved that the field of a similar machine introduced in the same place, gives the same result.

The Anglo-Japanese Oi-gawa Hydro-Electric Power Co. will supply electricity to Shizuoka and other cities on the Tokaido by utilizing the cataracts of the great Oi River. About 66,000 horsepower are available at Tamochimura; about 27,000 more between Ikama-mura and Hambaraumechi, and about 8,000 horsepower at Uchinakubi, in Yamanashi prefecture. The first, being the largest among the three works, will have to be postponed for some time. The second and third will be started in 1908 at an estimated cost of $5,000,000. The company is backed by a capital of $5,250,000, half of which will be equally subscribed by the British and Japanese promoters.

Approved Electrical Devices

This department from time to time will contain an illustrated description of all fittings approved by the Underwriters' National Electric Association.

ATTACHMENT PLUG, FUSELESS.

"Benjamin" 3A., 250V., Cat. No. 903, with rotating shell screw and outlet bushing or cap, holding cord without use of knot. Approved Feb. 10, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Boulevard, Chicago, Ill.

WEATHERPROOF PLUGS.

Cat. Nos. 5520 and 5522, 3A., 250V. Approved Feb. 17, 1908. Manufactured by

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CURRENT TAP.

Cat. No. 95½, 3A., 250V., series circuit current tap, for incandescent lamp in series circuit tapped from the device through special side outlet provided for this purpose. Approved Feb. 12, 1908. Manufactured by

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"D. & D." Ground Connection Clamp. A copper band looped through a ring in special bolt and secured by nut on this bolt. Approved Feb. 11, 1908. Manufactured by

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RECEPTACLES, STANDARD.

"Russell" two-piece porcelain receptacle. Cat. No. 276. Approved Feb. 7, 1908. Manufactured by

Freeman Electric Co., Trenton, N. J.

Bryant Receptacles, 3A., 250V. Sign, Cleat, Concealed, Moulding, Conduit Box and Rosette Receptacles. Approved Feb. 10, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

Weber Wall Sockets. Cat. Nos. 61672 to 61677, inclusive. Cleat, Concealed and Angle Base, types 3A., 250V. Approved Feb. 8, 1908. Manufactured by

Weber Electric Co., Schenectady, N. Y.

SIGNS, ELECTRIC.

N. B. Universal Monogram Signs. Metal frames, carrying, by means of slate strips, two plates in which are mounted lamp holders. Chargeable face plates. Approved Feb. 12, 1908. Manufactured by

Electric Carriage Call Co., Christopher St., near Washington St., New York City.

SOCKETS, STANDARD.

Weber brass shell key and keyless. Cat. 61,372 to 61,375, inclusive, 61,573 and 61,575. Approved Feb. 8, 1908. Manufactured by

Weber Electric Co., Schenectady, N. Y.

SWITCHES, PENDANT SNAP.

"Perkins" two-button type, single-pole, 6A., 125V., 3A., 250V. Cat. Nos. 2,353, 2,354, for either pendants or fixtures, and 2359 for fixtures only. Approved Feb. 17, 1908. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

WIRE, SLOW-BURNING.

Insulation consisting of three braids. See Rule 43, Nat'l Elec. Code (1907 edition). Approved Feb. 17, 1908. Manufactured by

Collyer Insulated Wire Co., Pawtucket, R. I.

CABINETS.

"Wurdack" built up and formed steel cabinets, with or without slate or asbestos gutters. Steel or wood fronts, with or without glass panel in door. Approved January 18, 1908. Manufactured by

Wurdack Elec. Mfg. Co., 19 S. Eleventh St., St. Louis, Mo.

CONDUIT OUTLET PLATE.

"Fancleve." Cat. Nos. 601-605, inclusive, for knob and tube work. Cat. No. 700, for flexible armored cable. Approved January 15, 1908. Manufactured by

John L. Gleason, 290 South St., Jamaica Plain, Mass.

LAMP CLUSTERS.

"Benjamin" newer multiple types, Nos. 5 and 5K, having metal ceiling plates, porcelain bodies and outer shells, without removable rings. Approved January 18, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Boulevard, Chicago, Ill.

RHEOSTATS.

Drum controllers of types, voltages and horsepower as described in manufacturer's bulletin Nos. 66, 66A, 67, 67½, 68, 68½, 69, 72B, 77 and 78. Approved January 18, 1908, when properly installed in connection with suitable resistance elements. Manufactured by

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

Form P. and P. M. resistance units. Sizes A, B and C. Asbestos tubes wound with resistance coil and covered with cement. Approved January 17, 1908, when suitably mounted on bases of non-combustible material. Manufactured by

General Electric Co., Schenectady, N. Y.

G. E. motor starting. Types S A and S B, with field control. Type S F A; also type R A, speed regulating rheostat for continuous duty; 125-500-volt. Approved January 18, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

SOCKETS, STANDARD.

Right angle and twin sockets, with swivelling, screw plug attachment. The twin sockets are arranged for two lamps in series. Cat. Nos. 941 and 942½. Approved January 18, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Boulevard, Chicago, Ill.

CONDUIT OUTLET PLATES.

"Fancleve." Cat. No. 601-605, inclusive, for knob and tube work. Cat. No. 700, for flexible armored cable. Cat. Nos. 171 to 175, inclusive, for use with canopies of fixtures where supply wires are in wooden moulding. Approved Feb. 29, 1908. Manufactured by

John S. Gleason, 290 South St., Jamaica Plain, Mass.

CURRENT TAP.

Cat. No. 95½, 3A., 250V., series current tap, for incandescent lamp in series circuit tapped from the device through special side outlet provided for this purpose. Approved Feb. 13, 1908. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Blvd., Chicago, Ill.

CUT-OUT BASES, CARTRIDGE FUSE.

Cut-out Bases, Cartridge Fuses, 250 and 600 volts, all capacities. Fuse terminals of standard dimension and spacing, mounted on slate bases. Also similar patterns on slate bases with slate barriers between parts of opposite polarity. Approved Feb. 25, 1908. Manufactured by

Trumbull Electric Mfg. Co., Plainville, Conn.

LIGHTNING ARRESTERS.

"Shaw Non-Arcing," for A.C. and D.C. circuits. Approved March 2, 1908. Manufactured by

Lord Electric Co., Fuller Bldg., New York, N. Y.

RHEOSTATS.

Multiple switch, motor-starting rheostats, described in Bulletin 10½. Approved Feb. 26, 1908, either when equipped with a push-button device or when equipped with "hand-over-hand" operation, with holding magnet on last lever, making it impossible to leave the starter with only a portion of the switches closed. Manufactured by

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

SIGN MACHINE.

"Skeedoodle J," 10, 15, 20 and 25 amperes, 125V., single or double pole. A thermostatic flasher consisting of carbon contactors carried on steel springs and mounted in cast-iron box, having pipe extension containing the thermal element. Approved Feb. 29, 1908. Manufactured by

Electric Ad. Company, 64 State St., Detroit, Mich.

SOCKET, WEATHERPROOF.

Freeman Weatherproof Socket and Vaporproof Globe, styles A, B and C, 3A., 250V. Approved March 2, 1908. Manufactured by

E. H. Freeman Electric Co., Trenton, N. J.

SWITCH BOXES.

"Fancleve" cast-iron conduit switch and outlet boxes. Cat. Nos. 501 and 351. Approved Feb. 28, 1908. Manufactured by

John L. Gleason, 290 South St., Jamaica Plain, Mass.

WIRE, SLOW-BURNING.

Insulation consisting of three braids. Approved March 2, 1908. Manufactured by

Benedict & Burnham Mfg. Co., Waterbury, Conn.

BUSHINGS.

"P. & S." All porcelain bushings for use on wood or steel cut-out cabinets. Supported by means of screw or stove bolts. Cat. Nos. 55, 56, and 57. Approved Feb. 24, 1908. Manufactured by

Pass & Seymour, Inc., Solway, N. Y.

CIRCUIT BREAKERS

Type K, Forms L, M, N, O, P, Q. All capacities, 250 and 600V. Approved Feb. 24, 1908. Manufactured by

Conduit Electrical Mfg. Co., Boston, Mass.

LAMP CLUSTERS.

"Dale" Wireless Clusters, types Nos. 197 and 130. Multiple only, type No. 227. Also above types with fixture stem, reflectors and shades. Approved Feb. 10, 1908. Manufactured by

The Dale Company, 9th Ave. and 13th and Hudson St., New York, N. Y.

PANELBOARDS.

125 and 250V., 2 and 3-wire boards equipped with knife switches and terminals for cartridge enclosed fuses. Approved Feb. 15, 1908. Manufactured by

Electric Mfg. Co., 926 Lafayette St., New Orleans, La.

RHEOSTATS.

C. H. Universal Motor Starters, described in Bulletin 21. Having overload motor starter and knife switch and terminals for N. E. cartridge enclosed fuses mounted on a slate base. Approved Feb. 21, 1908. Manufactured by

Cutler-Hammer Mfg. Co., Milwaukee, Wis.

FLOW OF WATER IN OPEN CONDUITS.

A. P. Merrill gives the following formula for calculating the flow of water in open conduits, in a recent number of "The Engineering Record":

$$V = C\, S^a\, R^b,$$

in which

V=velocity of flow in feet per second.

S=slope, or the sine of the angle of inclination of the conduit.

R=hydraulic radius, or the cross-sectional area of the stream divided by the length of the wetted perimeter.

The following is a summary of the numerical results:

Ordinary Conduits: $a = 0.43$; $b = 0.869/V^{0.25}$

	C
For unplaned plank	=78
For lath in flume .12′ c. to c.	=64
For lath in flume .25′ c. to c.	=44
For pure cement	=94
For small gravel	=56
For large gravel	=45
For brick (not very smooth)	=75
For smooth masonry	=77
For ordinary channels in earth	=22—32

Semicircular Conduits: $a = 0.46$; $b = 6.929/V^{0.25}$.

	C
For partly planed plank	=97
For pure cement	=114
For cement with one-third sand	=104
For small gravel	=74

Rivers and Large Canals: $a = 0.76$; $b = 1.552/V^{0.25}$; C=174 to 248.

It is seen that C in the above summary varies through a wide range for rivers and large canals. The investigation on these large streams was not sufficiently extensive to warrant giving a more definite co-efficient.

After the final exponential equation was determined, and the values for the co-efficient obtained, the writer computed, by the formula submitted, the values for the velocities, using each of the readings given in 43 of the tables used. With one exception, the average computed velocity for each table differed from the average measured velocity by less than six per cent, while in the majority of cases, the difference was under two per cent.

Wood poles to the number of 3,574,666 and worth $9,471,171 at the place of purchase, were used by telegraph, telephone and electric light and power companies during 1906, according to Forest Service Circular 137. Of these 60 per cent were cedar; 25 per cent chestnut; 5 per cent pine; 3 per cent cypress; 1½ per cent juniper; ¾ per cent redwood, and the rest oak, fir, and miscellaneous. The average price was $2.65 apiece, round poles selling for $2.63, and sawed for $4.22 each, there being only 47,791 of the latter. The telegraph and telephone companies purchased about two-thirds of the total, and the street railway, light and power companies about one-quarter. The Lake States furnished about half the total, and nearly 80 per cent of the cedar output, Idaho and Maine, with adjoining States, giving the bulk of the remaining cedar production. Chestnut poles come from Pennsylvania, Maryland, Virginia, and West Virginia; cypress poles from the Gulf States; juniper from Virginia, the Carolinas and other South Atlantic States; redwood comes wholly from California, together with pine, supplementing cedar on the Pacific Coast.

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VOL. XX MARCH 21, 1908 No. 12

EDITORIAL.

NEW SINGLE-PHASE MOTORS.

In compliance with a reader's request, we publish an account of the general theory of the repulsion motor and of commutation, as written by Mr. E. F. Alexanderson in describing "A Single-phase Railway Motor." As shown in the abstract of the paper presented before the American Institution of Electrical Engineers, printed in our issue of February 8, 1908, the characteristics of the repulsion motor give the desired starting qualities when combined with those of the series-compensated motor to obtain good running. In the new motor a winding produces the repulsion effect and compensates the armature reaction. The conductors are brought under the field poles at the time of commutation by means of a fractional pitch winding.

APPLICATION OF CHEMISTRY TO ELECTRICITY.

The aid given by electricity to chemistry is but little greater than what the chemist has done for the electrical engineer. Each inosculates and depends upon the other and exemplifies the strength given by co-operation. Chemistry forms the basis of all engineering work in this age of iron and copper. Confining our attention to the one branch of electrical engineering, we find chemistry entering into almost every factor from the generation to the utilization of the current. Power houses are often built of concrete, for whose strength and durability the chemist is responsible when he compounds and tests the cement. Dynamos are made largely from iron and copper, whose dependence have already been indicated. They are sometimes driven by steam, whose feed water must be examined and whose fuel as well as flue gases must be chemically analyzed, to gain the greatest efficiency. To the chemist is due the development of new lubricating oils, but as yet he has not found a successful substitute for rubber.

In transmission, the chemist has largely been concerned with the preparation of glass and earthenware insulators that would withstand the necessary stresses. Porcelain for electric purposes forms about 10 per cent of the total value of pottery products in this country. It is made either by a wet or a dry process, high-tension insulators being moulded and lathe-turned from the former, and knobs, cleats, receptacles, plugs, switch-bases, etc., being pressed from the latter. The right proportion of feldspar, clay and quartz determined by the chemist is essential to a uniformly good product.

Of the various high efficiency metallic filament lamps recently put on the market, none could have been developed without the chemist's knowledge of the proportions and method of extraction of these metals. A long series of careful chemical experiments preceded the mechanical manufacturing processes. The work of the chemist is likewise most essential in the development of accumulators, as well as primary batteries.

But even more fundamental has been its function in providing processes such as the cyanide and chlorination, whereby gold is extracted from refractory ores. Again, with regard to the commercial success of any product, a market must either exist, or be created, and while there has been but little trouble in the marketing of electricity, a time may come when the great current consumption of large electro-chemical industries will be welcomed. These are but some of the instances in which chemistry has been used as an aid for electricity and show how important its knowledge is to the engineer desirous of attacking a problem correctly. It makes obvious the contention that the community having the best chemists will most successfully compete with others for the concomitant advantages of commercial supremacy.

These facts and those in a discussion of the application of electricity to chemistry show that no one science can be given precedence over another, but all have advanced together, acting and reacting upon each other, just as they have influenced our art, our reasoning or our language.

THE JOVIATION OF THE REJUVENATED SONS OF JOVE.

At the Hotel Southland, Dallas, Texas, 7 p. m., February 29, 1908.

The Contractor's Soliloquy.

"To cut, or not to cut, that is the question.
Whether 'tis not better in the end
To let the chap who knows not the worth
Have the work at cut-throat price, or,
To take up arms against his competition,
And, by opposing cut for cut, end it.
To cut, and by cutting put the other cutter
Out of business; 'tis a consummation
Devoutly to be wished. To cut, to slash,
Perchance myself to get it in the neck,
Ay, there's the rub; for when one starts
To meet the other fellow's price, 'tis like as not
He's up against it good and hard.
To cut and slash is not to end confusion
And the many evils the trade is pestered with;
Nay, nay, Pauline; 'tis but the forerunner
Of debt and mortgage such course portends.
'Tis well to get the price the work is worth
And not be bullied into doing it
For what So-and-So will do it for.
Price-cutting doth appear unseemly
And fit only for the man who knows not
What his work is worth, and who, ere long,
By every stress of making vain comparison
'Twixt bank account and liabilities,
Will make his exit from the business."

Menu.

Jovian Rotary Converters
Neptune's Generators
Cut-outs Hang-outs Blow-outs
Electrolyte a la Lucifer
Submarine Boosters
Jupiter's Synchronizers
Apollo's Milk Turbines
Juno's Exciter
Insulating Joints au Avrenim
(New Code)
Ground Detectors Corroded Contacts
Rejuvenated Trouble Shooters
Vulcan's Soldering Paste
Polarity Indicator a la Pluto
Voltage Regulator de Hercules
Mars' Fuses
"SHOCKED"

PERSONAL.

J. W. McDowell, of the Manhattan Electrical Supply Co., of New York City, is in San Francisco on one of his annual trips.

Geo. R. Carr, vice-president of the Dearborn Drug & Chemical Works, is on a combination business and pleasure trip to the City of Mexico.

A. Press, formerly connected with Siemens & Halske, has become chief electrical engineer for the American Transformer Co., of Newark, N. J.

John W. Brashears, who for many years has been first assistant to W. A. Converse, chemical director of the Dearborn Drug & Chemical Works, in charge of their analytical laboratories, has been appointed assistant superintendent of the manufacturing department.

TRADE CATALOGUES.

H. Krantz Manufacturing Company, of Brooklyn, N. Y., send copies of their re-issued bulletin on ceiling switches without springs.

The F. Bissell Company, of Toledo, Ohio, send Bulletin No. 19, listing direct-current security switchboards for isolated and central-station plants.

Bulletin No. 4566, just issued by the General Electric Company, Schnectady, N. Y., describes some new types of tantalum lamps, which are now on the market. The lamps are rated for 40, 50, and 80 watts. Under the heading "Solution of Illuminating Problems," an interesting outline is given of the best methods of selecting proper units for various conditions.

The General Electric Tungsten Lamp for street lighting is described in Bulletin No. 4571. Data and prices, candlepower, distribution, curves, and illustrations of the lamp, and ornamental brackets used in street lighting are given. The lamps are rated at an efficiency of 1¼ watts per candlepower, with an estimated life of approximately 1,000 hours. On this basis a comparison of the carbon filament lamp, taking 3.5 watts per candlepower, shows that the G. E. Tungsten Lamp gives a saving of 90 kilowatt-hours per lamp, and at two cents per kilowatt-hour this makes the actual value of the tungsten lamp $1.80 greater than the carbon filament lamp.

One of the most artistic electric fan catalogues of the season is Bulletin No. 4560, just issued by the General-Electric Company. The catalogue is conveniently arranged for reference, two or three fan motors being shown on each page, with a brief description in tabulated form and data as to voltage, catalogue numbers, list prices, etc. Descriptions are included of ceiling fans, exhaust fans, and some miscellaneous small motors for blower, drills, buffing and polishing machines, sewing machines, etc. The general color scheme of the book is cream and brown, light tint blocks being used on all the pages. The frontispiece is an excellent reproduction of the painting, "Fame," by Edith Prellwitz, and the cover is a portrait medallion in bright colors.

NOTICE OF REMOVAL.

On and after March 1st, 1908, Harron, Rickard & McCone will be at 461 Market St., Sheldon Building. Shipping department and warehouses, Seventh and Berry Sts., as heretofore.

TRADE NOTICE.

The Engineering & Maintenance Company have been appointed agents for the Crocker-Wheeler Company, for Nevada and Northern California, with offices at 212 Front St., San Francisco. Mr. R. E. Martinez is president; J. W. White, vice-president, and E. O. Hampton, secretary, of this company, which will also conduct a general engineering business.

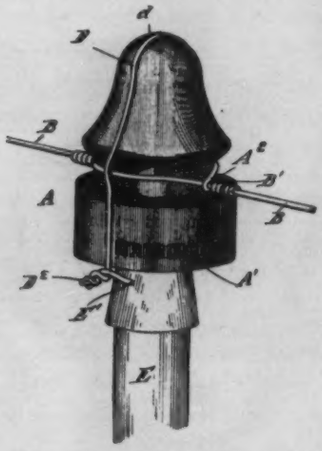
MEETING NOTICE.

The March meeting of the New York Section of the Illuminating Engineering Society was held at the United Engineering Societies Building, 33 West Thirty-ninth Street, on Thursday, March 12th, at 8:15 p. m. The paper of the evening was by Mr. E. L. Elliott, the subject being "The Relation of Illuminating Engineering to Architecture from the Engineer's Standpoint."

PATENTS

INSULATOR. 880,971. George W. Carter, Canyonville, Oregon.

An insulator body having an annular groove for a line wire and its fastening and provided above the said groove with a seat for a tie wire, and a peg receiving the insulator body at its upper end and provided below said body with a trans-



verse opening, and a tie wire passed through said transverse opening and around the insulator body and engaged with the upper seat thereof and having its ends united whereby to retain the insulator body in connection with the peg and the line wire in connection with the insulator body.

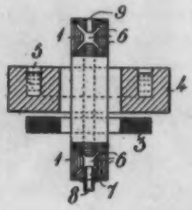
ELECTRODE ELEMENT FOR STORAGE BATTERIES. 880,978. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J.

An electrode element, comprising a perforated inclosing pocket non-deformable under normal working conditions, containing a highly compressed mass of active material, formed

with a net-work of minute circulating passages extending throughout the same and constituting a substantially predetermined porosity, and a net-work of conducting paths formed of overlapping flakes extending throughout the active mass and with which the particles are deformably compressed into intimate contact.

TRANSFORMER FURNACE. 880,547. Axel R. Lindblad and Otto Stalhane, Ludvika, Sweden.

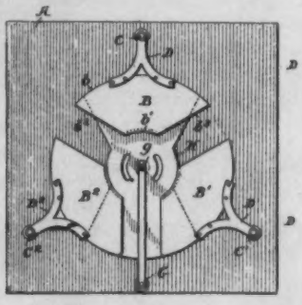
In a transformer furnace, a transformer core formed of an endless member, the member in cross-section being con-



stituted of sector portions meeting at the axis of the member, the sectors being formed of superposed parallel plates or laminae that in each sector are substantially perpendicular to the radius at the middle of the sector, each sector being separated by insulating material.

GROUND-DETECTOR. 880,544. Justus C. Lawler, Colorado Springs, Colo.

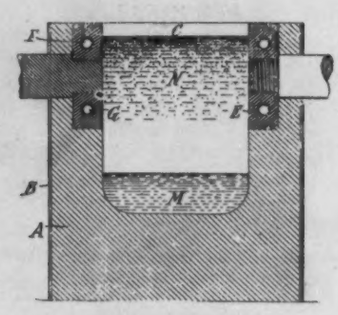
A ground-detector for three-phase electric circuits, com-



prising three plates in a single plane, each plate adapted to be connected to a different leg of the circuit, and a single vane common to the three plates mounted in a plane parallel to the plane of the plates and free to rotate.

ELECTRIC-FURNACE PROCESS. 880,743. Franz von Kugelgen and George O. Seward, Holcombs Rock, Va., assignors to Virginia Laboratory Company, New York, N. Y.

The method which consists in treating in an electric furnace a pyroconductive charge by passing through it from a



carbon electrode in contact with it a current sufficient to maintain the charge molten, and cooling said electrode sufficiently to cause a portion of the charge to be chilled in a protective but conducting coating thereon, whereby such chilled portion forms in effect a new working electrode.

INDUSTRIAL

THE TOMLINSON AUTOMATIC RADIAL CAR COUPLER.

When train operation of electric cars first came into general use, the necessity became apparent for an automatic coupler to fulfill the new conditions, which were different from those in steam road practice. This need was first felt on elevated electric railways, but of late years, with the extensive growth of interurban systems, train operation has become more common on surface lines, and the field of the automatic coupler is very much enlarged.

FIG. 1. TYPE A, FORM 1 NO 2 COUPLER FOR RECTANGULAR BAR DRAFT GEAR.

Among the various so-called automatic couplers of the radial type which have come into use in electric railway service, none has hitherto fulfilled the automatic function entirely, inasmuch as previous adjustment or rearrangement of the coupler parts is necessary in order to put the coupler in operative condition. The new Tomlinson automatic radial car coupler, manufactured by the Ohio Brass Company, is, however, a departure from previous practice in this respect, for it is absolutely automatic in action, and no previous adjustment of the parts is necessary to the operation of the coupler. There are no loose links or pins of any description.

FIG. 2. TYPE A, FORM 1, NO. 2, RECTANGULAR BAR DRAFT GEAR.

The Tomlinson coupler is of the radial type. All that is necessary to couple two cars is to align the couplers and bring the cars together with very little force. Any Tomlinson coupler will intercouple not only with another of its own type and size, but will also intercouple with all other standard radial couplers. By the addition of a simple emergency knuckle it will intercouple automatically with M. C. B. couplers. A combination link can also be furnished, which permits of intercoupling with Van Dorn couplers. These features, therefore, make the Tomlinson coupler a universal device applicable to the cars of any system regardless of the form of coupler already in use.

FIG. 3. TYPE A, FORM 2, NO. 3 CHANNEL BAR DRAFT GEAR. MADE ALSO IN THE NO. 2 SIZE.

The Tomlinson couplers are also made in sizes applicable to any class of service, from the lightest to the heaviest, and for application to any standard form of draft gear. In short, they are thoroughly practical in every respect, as has been abundantly proven by their satisfactory operation on many of the most prominent electric roads in the country. Following is a detailed description of the coupler, which will be made clear by the illustrations herewith, showing the various forms of the coupler and methods of application:

FIG. 4. TYPE A, FORM 2, NO. 3 COUPLER FOR CHANNEL BAR DRAFT GEAR. MADE ALSO IN THE NO. 2 SIZE.

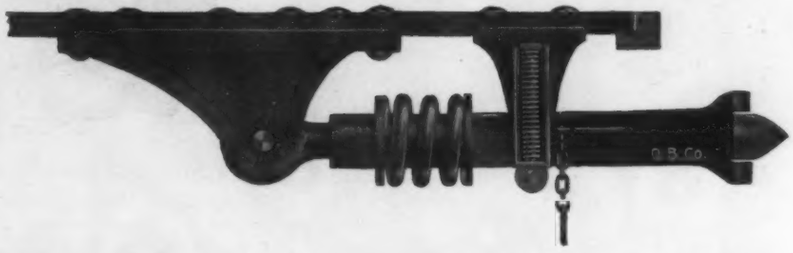


FIG. 5. TYPE A, FORM 4, NO. 3 COUPLER WITH DROP DRAFT GEAR AND SPRING HANGER. MADE ALSO IN THE NO. 2. SIZE.

The coupler, as shown clearly in Figs. 1 and 4, consists

essentially of a strong malleable iron head-piece which is hollow and contains an arrow-pointed, drop-forged coupler hook. This hook is pivoted at the end within the coupler, the arrow point being free to move horizontally. Its play in a horizontal direction is sufficient to allow the hooks of two opposing couplers to slide past each other and become locked. Horizontal movement of the hook beyond the center of the coupler is prevented, but the hook is free to

FIG. 6. TYPE A, FORM 3, NO. 2 COUPLER FOR RAIL SECTION DRAFT GEAR.

move toward the side of the coupler in opposition to the action of a spring. The arrangement is such, however, that should the spring in one of the couplers break, and allow the hook to move toward the side, there would not be sufficient clearance to permit the hooks to slide by each other

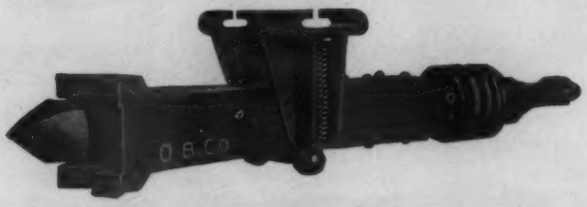


FIG. 7. DRAFT GEAR AND SPRING HANGER AS APPLIED TO TYPE A, FORM 2, NOS. 2 AND 3 COUPLERS.

and uncouple. The springs are under tension only at the instant of coupling or uncoupling, and get no stress of the train load, either pushing or pulling.

In uncoupling, the hooks are forced apart by a lever cam. The cam is actuated by a chain, a slight pull on the chain of either coupler being sufficient to disengage the

FIG. 7½. TOMLINSON-VAN DORN COMBINATION LINK.

hooks. After the couplers have separated, the parts return to their normal position automatically.

An important feature of the coupler, and one which effectually prevents lateral movement of the coupler heads is the serrated or saw-tooth form of the coupler face. The serrations on the faces of opposing couplers fit into one another, and when the couplers are locked, a practically rigid connection is made. Surging between cars, which results with couplers allowing lateral play, is, therefore, prevented, greatly facilitating the control of the train.

To meet service requirements the couplers are made in four forms for attachment to four standard types of draft gears, namely, rectangular bar draft gears, channel bar draft gears, 80-pound rail-section draft gears and drop draft gears. These four forms are shown in Figs. 1, 4, 5 and 6. Figs. 2 and 3 show respectively the rectangular bar and channel bar draft gears.

Beside variation in draft gear connections, the couplers are built in two sizes known respectively as size No. 2 and

FIG. 8. TOMLINSON AND VAN DORN COUPLED TOGETHER.

size No. 3. The No. 2 couplers are designed to meet the requirements of all classes of city and light interurban service. The No. 3 couplers are adapted to elevated and subway service, also heavy interurban service, and to all service where it is desired to intercouple with steam road cars.

FIG. 9. M. C. B. EMERGENCY KNUCKLE.

Where unduly sharp variations in the grade line make necessary some allowance for vertical play of the coupler and draft gear, the spring hanger attachment, shown in Figs. 5 and 7, is used. The hanger consists of a rectangular casting through which the draft gear passes, being supported by

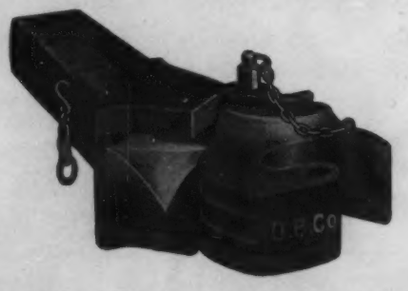


FIG. 10. TOMLINSON COUPLER WITH M. C. B. KNUCKLE.

a yoke which rests on springs, allowing vertical movement either up or down. These springs carry the weight of the coupler and draft gear, and normally hold the former in a position parallel to the car sills. The springs, however, allow vertical movement through a considerable range, so that the coupled cars can conform to any sudden breaks of grade, as caused by viaducts, subways, etc. (see Fig. 11). The hanger is supported by a radial slide bar under the car sills.

The M. C. B. knuckle (Figs. 9 and 10) is a device which makes possible the use of the Tomlinson coupler wherever it is necessary to intercouple with steam road cars. This knuckle is made with a wedge-shaped extension of the right

dimensions to fit into the space in the Tomlinson coupler which ordinarily receives the coupler hook of the opposing coupler. The knuckle is held in place by a pin which passes down through the Tomlinson coupler and the wedge-shaped extension of the knuckle. It is not necessary to remove or derange any of the parts of the Tomlinson coupler to put the knuckle in place, and when once inserted it will couple automatically with standard M. C. B. couplers.

The combination link for intercoupling with Van Dorn couplers (Figs. 7½ and 8), is applied similarly to the M. C. B. knuckle, and is provided with a tongue similar to that on the Van Dorn coupler.

Tomlinson couplers may be applied to any car regardless of its dimensions, distance from grade line to sills, etc., and as indicated by the diagrams, Figs. 12 and 13, the system is exceedingly flexible and can be made to conform to any operating conditions. This coupler is manufactured by the Ohio Brass Co., of ~~Bridgeport, Conn.~~ Mansfield, Ohio, represented by Pierson, Roeding & Company, of San Francisco.

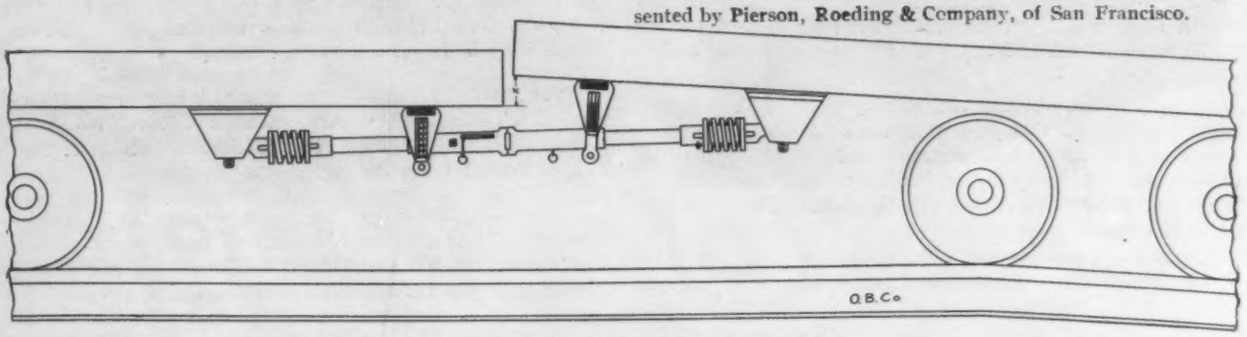


FIG. 11. SPRING HANGERS ADAPTING COUPLERS TO BREAK IN GRADE.

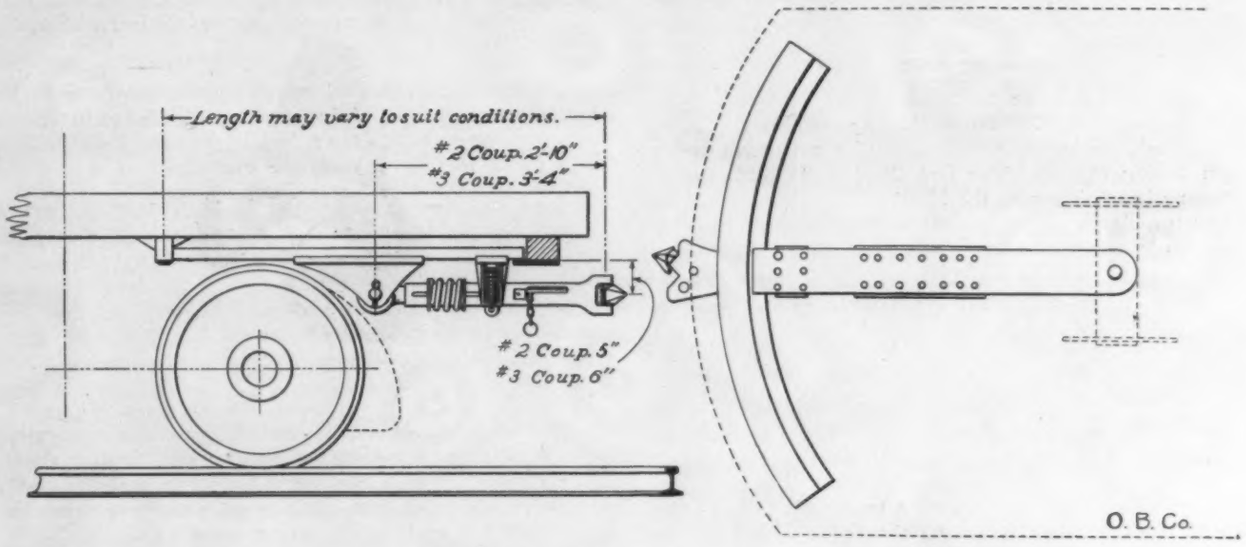


FIG. 12. SHOWING ADAPTABILITY OF TYPE A, FORM 4, COUPLER AND DROP DRAFT GEAR TO REQUIREMENTS OF VARYING CAR DIMENSIONS.

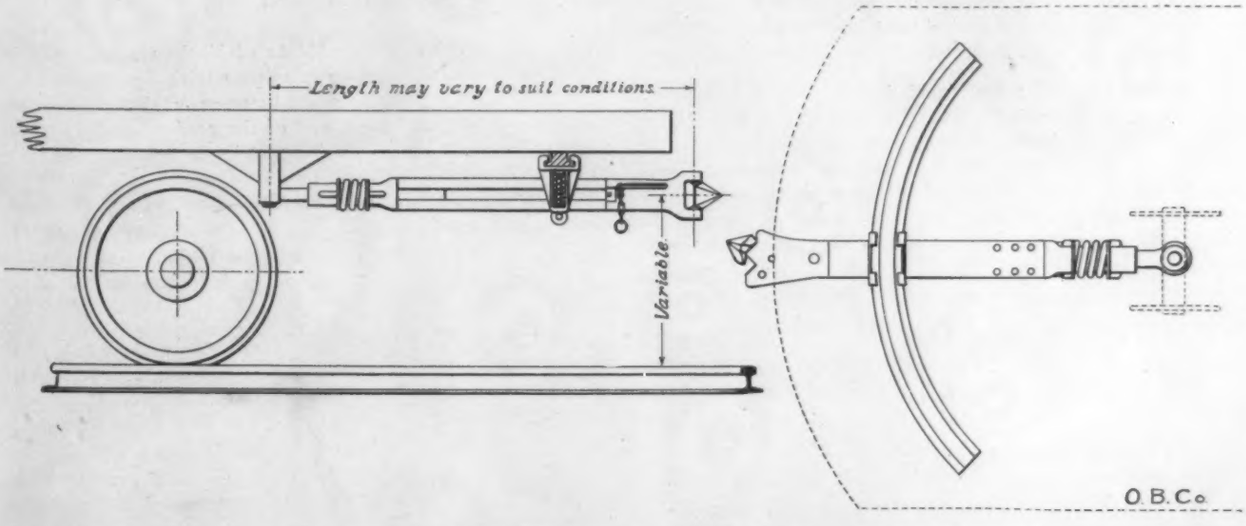


FIG. 13. SHOWING TYPE A, FORM 2, COUPLER WITH SPRING HANGER AND CLEARLY ILLUSTRATING ADAPTABILITY OF THE TOMLINSON COUPLER TO VARIOUS CONDITIONS OF SERVICE.

NEWS NOTES

TRANSPORTATION.

Bisbee, Ariz.—The branch of the Warren-Bisbee street car line, which will connect Bisbee with grounds of the Warren District Country Club, will soon be under way. It will be one and one-half miles long.

Stockton, Cal.—Unless the management of the Central California Traction Company withdraws its demand that all motormen and conductors furnish bonds indemnifying the company against loss through accidents, the employees of the entire system will walk out and tie up both the interurban and local lines.

Reno, Nev.—City Electrician Caffrey, of this city, states that the Virginia & Truckee Railroad Company is contemplating the plan of running all trains by electricity, and have asked him for estimates in regard to the cost of operating two trains each way between Reno and Virginia City each day, and several trains between Reno, Carson, Steamboat and other points.

Redding, Cal.—The franchise of the Redding & Red Bluff Railway Company was revoked by the Board of Supervisors, the time in which the work of construction was to begin having elapsed. The Red Bluff & Redding Railway Company is subsidiary to the Northern Electric. There will be no trouble to get a renewal of the franchise when the company is ready to begin work.

Oakland, Cal.—The need of additional cars for the Key Route has necessitated the increase of the working force at the car-shops on Hollis Street, by fifty men. The additional men went to work Monday morning. Many of them are men who had been laid off during the winter because of the slackness of work. The need of more cars for the Key Route had long been felt by the operative department.

Santa Ana, Cal.—A proposition to build a railroad from Tustin, through this city, across the Santa Ana River and through rich peat lands to Huntington Beach, was made recently by N. A. Ulm, and the Merchants and Manufacturers' Association gave its endorsement and ordered that a committee be appointed to secure subscriptions to stock. The line will be built by local capital, and will be operated independently. It will cost $150,000.

Stockton, Cal.—The first decided step taken to construct a road through the rich Manteca, French Camp, and Ripon District, to the south and east of Stockton, was taken, when articles of incorporation of the San Joaquin Investment Company were filed, with a Board of Directors composed of half a dozen prominent ranchers or property owners in the various localities through which the road will pass. One of the principal objects of the corporation is to secure rights of way for the electric road which will be built by the Central California Traction Company, with the assistance of the land owners and shippers along the route. The traction officials have been anxious to build to Modesto through the most thickly-settled portion of San Joaquin County, but could not see their way clear to pay fancy prices for rights of way. The farmers have taken up the matter, and indications are that work on the new road will be commenced early this summer, and while it may not be possible to complete the road to Modesto this year, it will ultimately be finished to that point.

TELEPHONES.

Mullan, Idaho.—Two ordinances were introduced asking for franchises for telephone lines, one being from the North Idaho and the other from the Interstate Company. The ordinances were laid over until next meeting.

Vancouver, Wash.—Moore & Harden, general contractors, were awarded the contract Saturday, March 7th, for the Home Telephone building for this city. Goodrich & Goodrich of Portland, are the architects.

Whitefish, Mont.—At the town election to be held on April 6th, the proposition of granting a telephone franchise to Carl Green will be passed upon by the voters, the franchise having been approved by the Town Council.

Montesano, Wash.—The petition of J. A. Phillips et al, for permission to construct a telephone line from Western to Markham along the Johns River road was granted, said telephone line to be so constructed as not to interfere with public travel on the road.

Cheney, Wash.—A deal was consummated Saturday by which Charles P. Lund of Spokane becomes the owner of the telephone system of this town, buying the same from William T. DuBois. For many years the exchange was owned and operated by the Pacific States Company.

Stevensville, Mont.—A city telephone exchange is to be installed in Victor within the next four months, and several independent rural lines are to be strung out from Victor to various places in the country tributary thereto. The exchange will be put in by the Rocky Mountain Bell Telephone Company, and the independent rural lines will connect with the Bell Company's wires in Victor.

Wallace, Idaho.—"We have our telephone line constructed as far as Lane, and are making a mile a day. Within thirty-five days we shall be to Wallace, and shall come right into the city and establish an exchange and enter business, regardless of the fact that we have not been granted a franchise." This was the statement of J. E. Markwell of Spokane, one of the officers of the Interstate Telephone Company, which recently applied for a franchise in Wallace, and which franchise the City Council tabled for five months.

Seattle, Wash.—The residents of Vashon Island will be placed in communication by telephone with Seattle within a fortnight. The submarine cable between Vashon Island and Tacoma will be laid by the end of the present week, and the Seattle line will be in working order a week later. The Farmers' Mutual Telephone Company, of which C. S. Wiley of the Title Trust Company, Seattle, is president, has 150 subscribers on Vashon Island. The line will be connected with the Seattle Independent Telephone Exchange.

Nez Perce, Idaho.—The Sunrise Telephone Company passed into the hands of the Nez Perce Co-operative Telephone Company and line connections were established. The Sunrise Company is a farmers' line running seven miles east of Nez Perce. At present fifteen farmers are served, but the line will be extended this spring. The Nez Perce Company, which is a mutual company composed of Nez Perce business men and farmers, has been active in acquiring farmers' lines, a fact which is shown by the addition of 150 instruments already connected.

FINANCIAL.

San Rafael, Cal.—By the issuance of $2,000,000 of bonds of the Marin Water & Power Company, which President A. W. Foster declares will be voted by the stockholders April 7th, new mains will be laid and a big reservoir built.

Petaluma, Cal.—There was delinquent but 144 shares out of 10,000 in the recent assessment of $10 per share on the Petaluma & Santa Rosa Railroad Company. The money goes to pay off the floating indebtedness. About $25,000 will be spent in new equipment.

Oakland, Cal.—The following table shows the gross earnings of the Oakland Traction Company for the last five years: 1903, $1,137,041.19; 1904, $1,258,135.65; 1905, $1,441,470.84; 1906, $2,226,017.11; 1907, $2,789,684.95. The surplus of the company for the past five years, after all charges of every character have been paid, was as follows: 1903, $268,381.92; 1904, $280,325.01; 1905, $308,148.87; 1906, $824,620.14; 1907, $848,881.25.

San Francisco, Cal.—The annual report of the Pacific Telephone & Telegraph Company for the year ending Dec. 31, 1907, showing the remarkable increase of $1,491,949 in gross earnings, equal to 19.3 per cent, reflects the full recovery of the system from the San Francisco disaster, and the growth of the telephone along the Pacific Coast. In point of capitalization and subscribers, this company is second in size to the New York Telephone Company, among the subsidiaries of the American Bell. During the year 1907 the company increased its bonded indebtedness by $8,750,000. Out of this it reduced its large floating debt by only $297,455 to $8,360,950 and established reserve accounts, amounting to $1,065,901, showing a cash expenditure in plant, real estate and equipment of $7,386,644. For this expenditure the book value of the plant, real estate and materials were increased in the balance sheet $6,826,550 to $36,690,538. The increase in the ratio of expense and charges to gross is due to the $10,000,000 of five per cent bonds sold in January, 1907. The gross receipts per station continue very low, about $15 below the average of all the Bell companies, due to the low rates maintained by the company and the rapid growth of the system.

TRANSMISSION.

Alamogordo, N. M.—M. H. Fisher, who will build the new central electric station in Alamagordo, has awarded the contract to the Alamo Development & Construction Company. Engineers of the company are already engaged in putting in the concrete foundations for the machinery.

Myrtle Point, Ore.—The Coquille Valley Power Company has its plans ready for a power plant at the head of Brewster Valley, development of which will give Coos County a light and power system with a capacity of 4,000 horsepower minimum. Water will be flumed for a distance of about 5,000 feet, when it will be given a 300-foot fall through a pipe line to the power house. The company has secured a three-acre site for a power house and 120 acres for reservoir site. Power will be transmitted to Myrtle Point, Coquille, North Bend, Marshfield and Bandon. A substantial power house will be built. There will be two units in water-wheels and two electrical units, being in duplicate.

Redding, Cal.—Harry L. Shannon has located 2,000 inches of the waters of Bear Creek, fifteen miles southeast of Redding. The water is to be diverted through a canal to a power-house site, where electrical power will be developed. Mr. Shannon was the organizer of the Northern California Power Company, and later of the Shasta Power Company, both of which are now delivering light and power in Redding and elsewhere. He is not now connected with either company. He says his location on Bear Creek is in good faith, and he will soon have another power company in the field, making the fifth in Shasta County. The other two are the Pacific Power Company and the Northern Light & Power Company.

Prescott, Ariz.—The Arizona Power Company has begun construction work. Mr. F. S. Viele, president of the Electric Operating Construction Company, who financed the plant, has been in the city for a few days, after having spent two weeks on the site of the plant in Arizona. Mr. M. A. Viele, of the firm of Viele, Blackwell & Buck, of New York, consulting engineers, also went over the work, and they have approved the plans for construction. Mr. R. S. Masson, representing the Electric Operating Construction Company, managers of the Arizona Power Co., is leaving to-night for Prescott, with Mr. H. A. Barre, also of that company, to take up the actual construction. Work will be rushed to a conclusion as rapidly as possible, and it is expected that power will be turned on within ten or twelve months.

OIL.

Santa Maria, Cal.—The Orange Oil Company has struck a large output at its new well, half a mile northwest of the Menges Oil Company property in Brae Canyon and on the north side of La Habra Valley. During the past few days it is reported that it has produced over 3,000 barrels of good gravity oil. The Hall Oil Company has secured territory near that of the Orange Company, and will put down a test well. The property which has been in the possession of the Japs in that section has recently passed into the hands of a private company, which will drill for oil.

San Francisco, Cal.—The report of the Associated Oil Company of San Francisco for the fiscal year ending December 31st, last, which has just been issued, compares with the previous year as follows: Gross income, $10,245,711, an increase of $3,735,924; expenses and taxes, $8,043,363, an increase of $3,852,814; net income, $2,202,348, changes decrease $116,890; interest on bonds, $144,354, changes increase $65,411; balance, $2.057,994, changes decrease $182,301; depreciation, $355,292, changes increase $126,540; surplus, $1,602,702, changes decrease $308,841.

Red Bluff, Cal.—The amount of fuel oil shipped into Red Bluff and consumed by the railroad company for its motive power last year, was very large. Statistics have been compiled for the year ending January 1, 1908, showing that a total of 802 carloads of oil had been emptied into the 55,000-barrel storage tank on the Duncan Hill, from which the 30,000-barrel tank on Madison Street receives its supply. An average of 1.075 locomotive oil-tanks were filled each month during the year at the Red Bluff oil stations. Orders lately received from the general office indicate that extensive improvements in the oiling plant are soon to be made.

ILLUMINATION.

Mendocino, Cal.—The Point Arena Electric Light Plant is to be improved by installing an oil-burning apparatus.

Banning, Cal.—A gas plant will be installed here within the next three months, with a capacity sufficient to furnish light and heat for the town. Local capitalists are back of the project. The company has been incorporated. The contract for installing the system has been let to J. R. Thompson, of Los Angeles.

Seattle, Wash.—Bids have been opened by the Board of Public Works for copper wire for the municipal lighting plant. There were seven bidders, and their quotations were all the same. The specifications call for bids on two grades of wire, one a total of 250,000 pounds, and the other a total of 398,000 pounds. It was decided to use the heavier grade of wire, and the contract will be let at the next meeting of the Board. The total cost of this material will be $64,078.

Nogales, Ariz.—Guallermo Dominguefi, of Los Angeles, who is here, states that within a year from next April a gas manufacturing company, equipped to use fuel oil, will be erected in Guadalajara, Mex., to cost $300,000. H. N. Session, of Los Angeles, will draw the plans. An effort will be made to secure oil from either the Mexican Petroleum Company or the Pearson interests. If this cannot be done it will be imported from California, through Port Manzanillo.

Lakeport, Cal.—The Lake County Electric Power Company has had the Kelseyville natural gas subjected to thorough chemical tests and analyses, and finds it not altogether suitable for power purposes. It contains so large a percentage of carbon dioxide (64.3), and so small a percentage of methane (35.7) that its use as a fuel for power purposes on a large scale will not be profitable. This fact has caused the company to drop the "gas mound" proposition. B. H. Henderson, on his own responsibility, has leased the property, with an option to purchase, and will continue the distribution of gas to the people of Kelseyville for fuel for domestic use. There is plenty of natural gas in Lake County, extending over a belt twenty-five miles long, and some of it runs as high as ninety-eight per cent in methane. The necessity of developing other gas fields will delay the company's operations somewhat, but it is going ahead along other lines. The first contract for poles, enough for eight miles of the line, is almost completed, and another and larger contract will soon be let. Part of the poles were delivered along the line some time ago. The others will be left in the woods until the roads are better.

INCORPORATIONS.

Bakersfield, Cal.—The Juanita Oil Company has been incorporated with a capital stock of $100,000 by J. P. Kerr, E. S. Mosher and J. M. Danzeger.

Los Angeles, Cal.—The Pacific Petroleum Company has been incorporated with a capital stock of $100,000. The directors are M. H. Whittier, H. B. Lee, John Wootan, E. T. Stoddard and C. B. Anderson.

San Francisco, Cal—The Elk Horn Oil Company, with a capital stock of $2,000,000, has been incorporated by L. E. Goble, T. O. May, F. M. Graham, A. Y. Chamberlin and J. G. Jury. The place of business is San Francisco.

Oakland, Cal.—Articles of re-incorporation for $1,000,000 have been filed by the Suburban Light & Power Company. The directors are Charles A. Jeffery, R. W. Geisenhofer, L. B. Smith, William Lucio, A. J. Lloyd, Jacob Harber, Jr., and J. W. Burge. The principal place of business will be in San Leandro.

Los Angeles, Cal.—The Southern California Gas Circuit Company has been incorporated with a capital stock of $500,000 by president, Berthold Baruch; vice-president, Herman Cohn; second vice-president, James W. Hellman; treasurer, M. A. Newmark; secretary and counsel, Samuel T. Mock, all of Los Angeles. The object of the company is to supply gas to Hollywood and Sherman, together with the section between Glendale and Hollywood. The generating plant will be located between Colegrove and Sherman.

TELEPHONE AND TELEGRAPH.

Ukiah, Cal.—Permission has been granted by the Board of Supervisors to F. W. McCracken, to erect a telephone from Ukiah to Redwood Valley.

Napa, Cal.—The Pacific States Telephone & Telegraph Company has leased to the Northwestern Electric Company its local and rural lines at Calistoga, reserving the long-distance business. The Pacific States Company claims that local business in small towns has long been a losing proposition to it, and recently leased to the same company its lines in several of the smaller towns in Sonoma County. The Northwestern Electrical Company last week bought the lines of the Calistoga and Clear Lake Telephone Company, which takes in all of the springs resorts in Lake County. A new $30,000 switchboard has been ordered for this city.

Washington, D. C.—Cable communication with Alaska has been restored. The Alaskan-Valdez cable, controlled by the Signal Corps of the Army, which was broken several weeks ago, supposedly by an earthquake, has been repaired by the Army cable ship "Burnside," and business has been resumed. The Alaskan cables are doing an enormous business. Captain Alexis E. Jennot, Thirteenth Infantry, detailed to the Signal Corps, will leave Washington in May, to begin active operations in the construction of the three big wireless telegraph stations of the United States Army Signal Corps in Alaska. One of these stations will be at Nome, one at Fort Gibbon, and the other at the eastern end of the mouth of the Yukon.

POWER AND LIGHT.

Juneau, Alaska.—The Council, at its meeting last night, granted a franchise to the Juneau Electric Light Company for a term of fifty years. The rates of the company were attacked by local people, but the franchise was granted, nevertheless. A movement is on foot to have injunction proceedings brought to prevent the franchise from becoming operative.

New Westminster, B. C.—Gilley Bros. have been granted a record of 100 inches of water from an unknown stream emptying into Pitt River, on the west side, through the N. S. one-quarter section of Section 22. The water will be used for generating power for crushing rock at the concern's Pitt River quarry. At present the rock-crushing is being operated by steam power.

Bellingham, Wash.—A hydraulic engineer of Denver, Colorado, visited the upper Skagit last week and investigated the water power above Marblemount. It is reported that he represents Denver capitalists who contemplate developing this power during the coming season. The water right on this section of the river was filed on two years ago, the supposition being that the location was being made for Stone & Webster. Another party of Denver men is expected to arrive there within the next two weeks. The filing covers the gorge of the Skagit, twenty-five or thirty miles above Rockport.